

# Handling Runoff From Solid Agricultural Source Material Storages and Outside Livestock Areas

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## Factsheet

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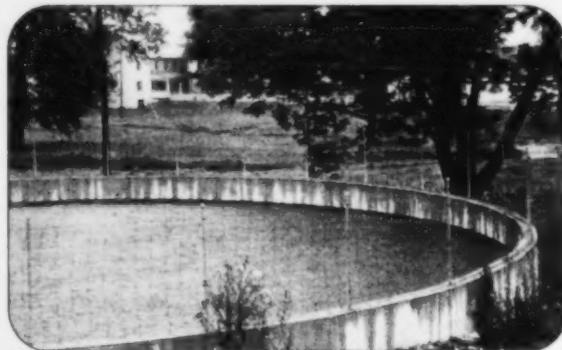
### INTRODUCTION

Uncovered manure storage facilities, livestock yards and permanent outdoor confinement areas are exposed to rainfall and snowfall. These liquids and any others, such as urine, that are not absorbed by the manure are called "runoff" when they leave the facilities. This Factsheet discusses runoff components and provides options for Ontario farmers to manage runoff from livestock yards and manure storage facilities in compliance with the *Nutrient Management Regulation*, O. Reg. 267/03 (the Regulation). Many of the terms used in this Factsheet are defined in Section 1 of the Regulation.

Most people recognize runoff as a brown or black liquid. In accordance with the Regulation, it can be described as liquid that:

- has come into contact with manure in a permanent nutrient storage facility, temporary field nutrient storage site, outdoor confinement area or livestock yard lined with concrete or other paving material of equal or lesser permeability
- may contain components of manure in solution or suspension, and
- is no longer contained in the permanent nutrient storage facility, temporary field nutrient storage site, outdoor confinement area or livestock yard

Runoff from these facilities must be managed to prevent it from flowing over the ground and contaminating surface water as defined in Section 2 of the Regulation or leaching to groundwater where it may degrade water quality. Contamination caused by runoff can be chemical – nitrates and phosphates – and/or biological – bacteria, viruses and parasites.



**Figure 1.** Runoff can be stored in an open-top concrete tank.

Farmers who are subject to the Regulation are required to manage their runoff so it does not harm surface water or groundwater. Water quality is also protected under the *Ontario Water Resources Act* and the *Environmental Protection Act*.

For operations required to have a nutrient management strategy or plan, the Regulation requires that, unless they have a runoff management system (Figure 1) capable of handling all runoff generated by the facility (S.81), no one:

- store nutrients in a permanent solid nutrient storage facility, or
- keep farm animals in a livestock yard lined with concrete (or other equivalent paving material) or in a permanent outdoor confinement area (OCA)

### RUNOFF QUALITY

Runoff may have solid and liquid components. Typically, urine, washwater and contaminated water make up the liquid portion, while the solid portion consists of manure, bedding, feed and soil.

**Table 1.** Constituents Contained in Runoff

Nutrients	Microorganisms	Compounds
Nitrates <sup>1</sup>	bacteria <sup>3</sup> , e.g., <i>E. coli</i>	organic
Phosphorus <sup>2</sup>	parasites	inorganic
Potassium	viruses	

<sup>1</sup> Although the long-term effects of nitrates on human health are not known, it is not a good practice to drink water containing nitrates. The recommended maximum acceptable concentration of nitrate as stipulated by Ontario Drinking Water Standards is 10 mg/L.

<sup>2</sup> Phosphorus increases algae growth in surface water. When the algae dies and decays in surface water, it uses up oxygen, resulting in potential fish kills.

<sup>3</sup> Pathogenic bacteria such as *E. coli* can cause disease in humans and livestock when they get into drinking water supplies.

The constituents in runoff can be broken down into three categories as shown in Table 1. Many of the same contaminants that are found in runoff may also be found in liquid manure. Typically, runoff has a very low solids content (often referred to as dry matter content), resulting in considerably lower constituent levels than liquid manure.

Table 2 provides typical constituent levels for runoff and liquid dairy manure. The values show that runoff is a very dilute and lower-risk material as compared to liquid dairy manure.

## RUNOFF VOLUME

Section 81 of the Regulation states that permanent OCAs, permanent solid nutrient storage facilities and paved livestock yards must be equipped with a runoff management system that handles all the runoff generated by the facility. Table 5.2 of the *Nutrient Management Protocol* outlines the accepted values for rainfall effects when estimating the amount of runoff generated by a livestock yard, OCA or solid storage (Table 3). Current versions of OMAFRA's NMN software also use these values and can be used to estimate the volume of runoff generated by these facilities. This volume is dependent on the factors outlined in Table 3.

**Table 2.** Constituent Concentrations in Runoff and Liquid Dairy Manure

Constituents	Runoff	Liquid Dairy Manure
Nitrogen	0.04%	0.36%
Ammonium nitrogen	241 ppm	1,527 ppm
Phosphorus	0.01%	0.09%
Potassium	0.09%	0.24%
Dry matter	0.6%	8.5%
Biological oxygen demand	1,400 mg/L	15,000–30,000 mg/L *

\* A recognized value in Ontario for liquid dairy manure.

In general, runoff volumes from permanent outdoor confinement areas, permanent solid nutrient storage facilities and paved livestock yards are much higher than anticipated by the farmer. For example, a permanent outdoor confinement area can produce up to 36.6 cm (1.2 ft) of depth of runoff per square foot of the outdoor confinement area over a 240-day period. This runoff amount depends on the dry matter content of the manure and manure quantity in the confinement area during this period. A significant percentage of the liquid that falls on a permanent outdoor confinement area, a permanent solid nutrient storage facility or paved livestock yard can be absorbed by solid manure. This absorptive factor has been accounted for in the 0.56 m/year referred to in Table 3. However, when there is a small amount of solid manure in the confinement area, more runoff will result.

## REDUCING POSSIBLE RUNOFF

Before constructing a runoff management system, the amount of possible runoff can be minimized by directing all clean water away from the permanent outdoor confinement area, permanent solid nutrient storage facility or paved livestock yard before it is allowed to come into contact with manure. Directing clean water away from the facility will not only reduce the volume of contaminated runoff that has to be managed, but it will also keep the facility drier, making it more desirable to work in.

**Table 3.** Factors Used to Calculate Runoff Volume

Design Factor	Explanation
Rainfall intensity, duration and frequency	The <i>Nutrient Management Protocol</i> provides a provincial standard of 0.56 m/year as an estimate of the amount of runoff generated per square metre of facility.
Lot or manure storage surface area	A smaller surface area reduces the runoff volume, which reduces the size of the runoff treatment or storage system.
Dry matter content of solid manure	Depends on the type of livestock, amount of bedding or water added.



**Figure 2.** An eavestrough system directs clean water away from the outside yard.

Surface water moving over the ground from higher elevations may be diverted by installing berms, ditches or other features, while eavestroughs on buildings can direct roof water away from these areas (Figure 2).

### **RUNOFF MANAGEMENT SYSTEMS**

If possible, consider how runoff is to be managed at the planning stage of the manure storage facility, livestock yard or outdoor confinement area. If the facility or area is not covered, provide a small slope (1%–2%) on the floor to one corner to allow the runoff to be collected and managed at one location. A screening system, such as a picket fence, and/or a small settling area at this low point will screen the solids and allow them to settle out. The liquids will drain to the runoff management facility.

The Regulation allows for five runoff management systems to be used on farms.

1. Roofed storage or roofed outside yard
2. Collection and storage system
3. Vegetated filter strip system
4. Another treatment system regulated under either Part 8 of the *Building Code* or under Section 53 of the *Ontario Water Resources Act*.
5. Permanently vegetated area

#### **1. Roofed Storage or Roofed Outside Yard**

Constructing a roof over a permanent solid nutrient storage facility, permanent outdoor confinement area or paved livestock yard will prevent rain and snow from entering the facility (Figure 3). As long as up-slope water has been diverted, a roofed system reduces runoff volume, since rain and snowmelt do not need to be stored or treated. If precipitation enters the nutrient storage facility, the additional water may also change the dry matter content of the manure, which may change the type of storage system used.



**Figure 3.** Placing a roof over a permanent solid nutrient storage facility eliminates runoff.

### **2. Collection and Storage System**

Runoff may be collected and stored in a permanent liquid nutrient facility to be spread on cropland as a nutrient source. The storage facility may be constructed of concrete, steel or earth. See Sections 64 to 67 and 71 of the Regulation for the requirement regarding the need to employ a professional engineer or professional geoscientist for siting, design and construction of the storage facility. The initial construction or expansion of a permanent liquid nutrient storage facility must comply with the Regulation.

Section 63 of the Regulation stipulates the following siting requirements for runoff containment facilities:

- Facilities must be 15 m from a well drilled 15 m or deeper, with watertight casing to a depth of at least 6 m below ground level.
- Facilities must be 100 m from a municipal well.
- Facilities must be 30 m from any other well (if storing agricultural source materials).
- Facilities must be 15 m from field drainage tiles or piped municipal drains.
- Drainage tiles within a 15-m zone around the storage system must be removed, and field drainage system or piped municipal drains must be redirected away from the facility.
- Drainage systems constructed within the 15-m zone of the facility must use non-perforated pipe with all subsurface joints sealed, unless the collected water discharges to a treatment system or to foundation drains of the storage facility equipped with an observation and shut-off station.
- There must be a flow path at least 50 m long from the storage to the nearest top of bank of surface water or tile inlet.
- No construction is allowed in 1-in-100 year flood lines unless a permit is issued under Section 28 of the *Conservation Authorities Act*.



**Figure 4.** Runoff may be transferred to a vegetated filter strip for treatment.

Permanent nutrient storage facilities and livestock housing facilities must be sited to meet municipal bylaw requirements. In most cases, the siting will be calculated based on the Minimum Distance Separation II (MDS II) formula. Contact the municipality about siting prior to applying for a building permit.

### 3. Vegetated Filter Strip System

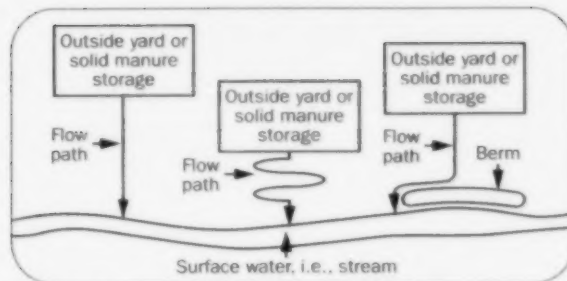
A vegetated filter strip system (VFSS) is a runoff treatment system. The Regulation provides design, construction, operation and maintenance criteria for this type of runoff treatment system. If these standards are not met, a Certificate of Approval for a sewage works under the *Ontario Water Resources Act* must be obtained.

A vegetated filter strip system means the complete system required to treat runoff and includes temporary storage, screening and transport of runoff, including a pump, if required, and the vegetated filter strip. The vegetated filter strip, or infiltration area, is a densely vegetated strip of land, engineered and constructed to accept and manage agricultural runoff and washwater by settling, filtration, dilution and absorption of pollutants and infiltration into the soil.

Runoff is collected and stored in a settling basin, which could be:

- a curbed area on the paved livestock yard or OCA
- a curbed pad adjacent to the permanent solid nutrient storage facility, or
- a separate external basin

From the settling basin, the runoff either flows by gravity or is pumped to the vegetated filter strip. A perforated distribution pipe is located across the top end of the filter strip to distribute the runoff along the width of the strip (Figure 4). Treatment occurs as runoff moves down the strip. For more information on the design and siting of the vegetated filter strip system, visit [www.ontario.ca/omafra](http://www.ontario.ca/omafra).



**Figure 5.** Different flow paths of the same required length.

### 4. Another Treatment System

Other types of treatment systems may be appropriate for farm operations in certain circumstances. The regulation allows for the use of treatment systems other than a VFSS, but these systems must be approved under either Section 53 of the *Ontario Water Resources Act* or Part 8 of the *Building Code*. Examples of these other treatment systems could include a septic tank and weeping bed system or a constructed wetland.

### 5. Permanently Vegetated Area

A permanently vegetated area can be a permanent pasture, permanent hayfield or forested area that the runoff flows over. The permanently vegetated area is not tiled and must meet all the following criteria:

- have 0.5 m minimum soil depth
- be at least 3 m from field tile drains
- be at least 100 m from municipal wells
- be at least 15 m from drilled well
- be at least 30 m from any other well

A permanently vegetated area can only be used as the runoff management system in certain lower risk situations. To use this runoff management option, the manure in the storage facility or paved livestock yard must be at least 30% dry matter.

The area where the runoff flows over the permanently vegetated area is referred to as a flow path. The flow path runs through the permanently vegetated area and can be a surface channel or depression that conducts the runoff away from the facility. Treatment occurs as the runoff moves along the length of the flow path.

The flow path from the facility to surface water must be a minimum length. The flow path may go directly from the facility to surface water, meander back and forth or be located parallel to a berm along surface water to achieve the minimum length required (Figure 5).



Drier manure has less potential for runoff, therefore a shorter length of flow path to surface water is permitted. For larger facilities, multiple flow paths may be required.

Further details regarding permanently vegetated areas may be found in Section 81 of Ontario Regulation 267/03, as amended.

## FACILITIES REQUIRING RUNOFF MANAGEMENT

Under Section 81 of the Regulation, permanent outdoor livestock confinement areas, permanent solid nutrient storage facilities and livestock yards paved with concrete or other suitable material require a runoff management system that will handle all the runoff generated by the facility.

### Permanent Solid Nutrient Storage Facilities

Section 81(1) of the Regulation requires that a permanent solid nutrient storage facility be equipped with a runoff management system capable of handling all the liquid generated by the facility.

#### Options for Handling Runoff

See Table 4.

- roof over permanent solid nutrient storage facility (must divert up-slope water away from facility)
- runoff collection and storage system that meets standards under Part VIII of the Regulation, i.e., concrete/steel tank or earthen storage
- vegetated filter strip system
- other treatment system (with appropriate approval)
- permanently vegetated area (must divert up-slope water away from facility) can be used if the facility:
  - produces a minimum 30% dry matter content of manure
- has a flow path length (paved livestock yard to surface water or tile inlet) of:
  - at least 150 m for manure with dry matter content of 30% or more
  - at least 50 m for manure with dry matter content of 50% or more

### Paved Livestock Yards

Paved livestock yards typically are "exercise" yards where no feeding or watering occurs or where the animals are present for less than 200 days per year.

Section 81(2) of the Regulation requires that a livestock yard paved with concrete or other acceptable material, other than a permanent outdoor confinement area, be equipped with a runoff management system capable of handling all the liquid generated by the facility.

**Table 4.** Runoff Control Management Options for Permanent Solid Nutrient Storage Facilities

Manure Dry Matter Content	Runoff Control Options*
18% to <30%	Roofed storage (no runoff)
	Runoff storage
	Vegetated filter strip system
	Other treatment system (with appropriate approval)
30% to <50%	Roofed storage (no runoff)
	Runoff storage
	Vegetated filter strip system
	Other treatment system (with appropriate approval)
	Flow path, minimum length of 150 m**
50% or more	Roofed storage (no runoff)
	Runoff storage
	Vegetated filter strip system
	Other treatment system (with appropriate approval)
	Flow path, minimum length of 50 m**

\* All options include a requirement to divert up-slope water away from the facility.

\*\* Where solid manure storage floor area is less than 300 m<sup>2</sup>.

#### Options for Handling Runoff

All options include a requirement of diverting up-slope water away from the facility.

- roof over paved yard
- runoff collection and storage system that meets standards under Part VIII of the Regulation, i.e., concrete/steel tank or earthen storage
- vegetated filter strip system
- other treatment system (with appropriate approval)
- permanently vegetated area (See *Permanently Vegetated Area* in this Factsheet for site criteria.) can be used if the facility:
  - produces a minimum 30% dry matter content of manure
- has a flow path length (paved livestock yard to surface water or tile inlet) of:
  - at least 150 m for manure with dry matter content of 30% or more
  - at least 50 m for manure with dry matter content of 50% or more



**Figure 6.** Runoff is generated from permanent outdoor confinement areas.

### Permanent Outdoor Confinement Areas

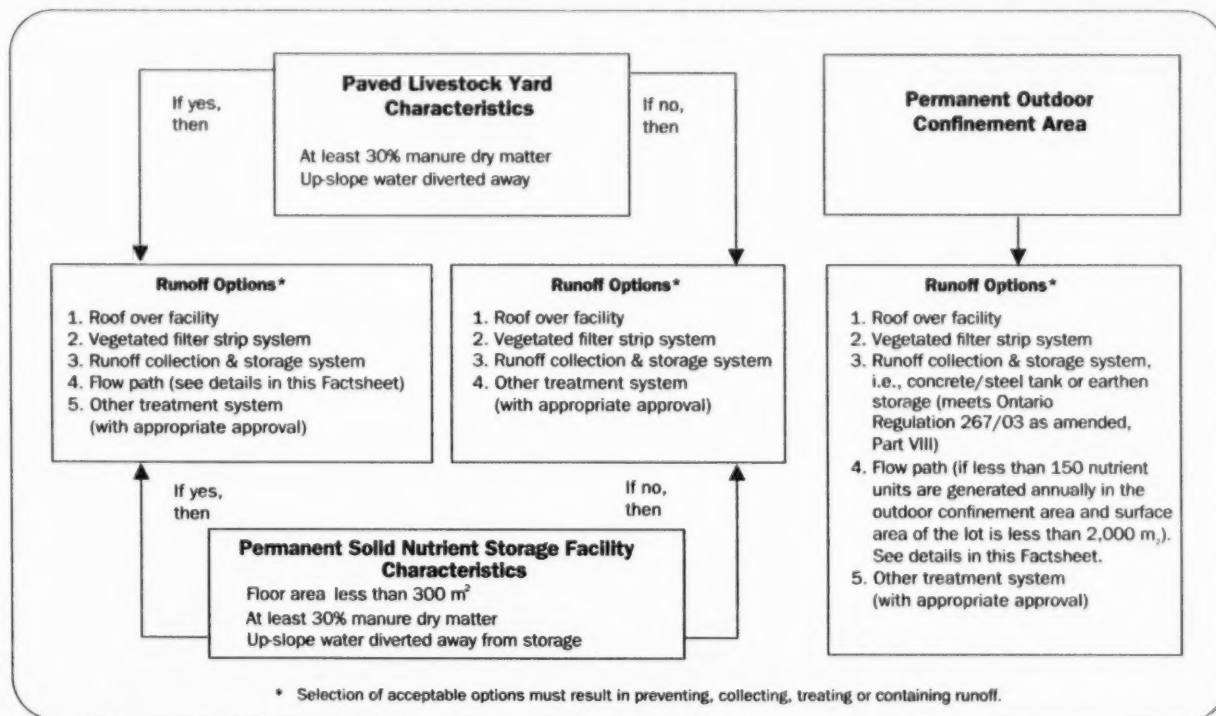
Section 81(3) of the Regulation requires that a runoff management system be provided for all permanent outdoor confinement areas (Figure 6). The runoff management system must be composed of natural or manufactured runoff collection, treatment and containment devices that are capable of preventing, collecting, treating or containing runoff. Select from the options presented below, keeping in mind that the

objective of preventing, collecting, treating or containing runoff must be met.

### Options for Handling Runoff

All options include a requirement of diverting up-slope water away from the facility.

- roof over confinement area
- runoff collection and storage system that meets standards under Part VIII of the Regulation, i.e., concrete/steel tank or earthen storage
- vegetated filter strip system
- other treatment system (with appropriate approval)
- permanently vegetated area (See *Permanently Vegetated Area* in this Factsheet for site criteria.) can be used if the facility:
  - generates less than 150 nutrient units annually in the area
  - has a maximum outdoor confinement area of less than 2,000 m<sup>2</sup> per flow path.
  - uses a minimum flow path length of 100 m for outdoor confinement areas under 500 m<sup>2</sup>
  - uses a minimum flow path length of 150 m for outdoor confinement areas 500 m<sup>2</sup> to <2,000 m<sup>2</sup>



**Figure 7.** Overview of runoff options for permanent outdoor confinement area, permanent solid nutrient storage facility and paved livestock yard.

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### **Do you know about Ontario's Nutrient Management Act?**

The provincial *Nutrient Management Act* (NMA) and the Regulation 267/03, as amended, regulates the storage, handling and application of nutrients that could be applied to agricultural crop land. The objective is to protect Ontario's surface and groundwater resources.

Please consult the regulation and protocols for the specific legal details. This Factsheet is not meant to provide legal advice. Consult your lawyer if you have questions about your legal obligations.

For more information on the NMA, call the Nutrient Management Information Line at 1-866-242-4460, e-mail [nman.omafr@ontario.ca](mailto:nman.omafr@ontario.ca) or visit [www.ontario.ca/omafr](http://www.ontario.ca/omafr).

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